Teaching Technical Communications to Engineering Technology Students: A Case Study Approach

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Abstract

One alternative to a long term-paper assignment in a technical writing course is the short memo. Engineering technology students enrolled in Ms. Ford's sections of Technical Writing, English 202C, at Penn State University—Altoona College are required to write a number of memos and short reports in response to case studies. These case studies are designed to approximate the types of writing students will be doing in their careers. When English instructors work together with engineering faculty, they can write more realistic cases and can build upon skills the students are learning in their engineering technology classes. Similarly, engineering faculty can consult with the English instructor to incorporate memo and report writing skills into the students' engineering projects. This paper reports on efforts by the English and engineering faculty members to complement each other's assignments so that students will acquire skills in both engineering and communication. Sample cases are presented.

Introduction

The Accreditation Board for Engineering and Technology (ABET) has developed a new set of accrediting criteria for engineering programs in the United States requiring accreditation-seeking programs to demonstrate that their graduates have an ability to communicate effectively. The integration of written, oral, and visual communications into engineering/engineering technology courses is important because 1) the ability to communicate effectively is crucial to the success of engineering/engineering technology graduates in their careers and 2) language is a powerful tool for learning. An effective instructional model for teaching communications to engineering/engineering technology students may include 1) Writing and speaking assignments designed to promote active learning and collaborative problem solving. 2) Communications in workplace settings. Examples of such forms of communications are technical memos, engineering case studies, and technical feasibility reports.

In order to meet the need for providing instruction in technical communications, all baccalaureate degree engineering and engineering technology students at the Pennsylvania State University are required to take English 202C (Technical Writing) in addition to English 15 (Rhetoric and Composition). The course objectives for English 202C as outlined by the Penn State University English Department are listed as follows:

> ENGL 202C, Technical Writing, serves students who are studying and preparing for careers in the sciences and applied sciences (particularly engineering). This advanced course in writing familiarizes students with the discourse practices prized in their disciplinary and institutional communities—and helps them to manage those practices

effectively in their own written work. In this way the course teaches those writing strategies and tactics that scientists and engineers will need in order to write successfully on the job. Accordingly, students in the course can expect to:

- Discover and understand the discourse features that distinguish their disciplinary and institutional communities from others.
- Discover and specify the purpose(s) of their writing.
- Develop a range of writing processes appropriate to various writing tasks.
- Identify their readers and describe the characteristics of their readers in a way that forms a sound basis for deciding how to write to them.
- Invent the contents of their communications through research and reflection.
- Arrange material to raise and satisfy readers' expectations, using both conventional and rhetorical patterns of organization.
- Reveal the organization of their communications by using forecasting and transitional statements, headings, and effective page design.
- Observe appropriate generic conventions and formats for letters, résumés, memoranda, and a variety of informal and formal reports.
- Design and use tables, graphs, and technical illustrations.
- Compose effective sentences.
- Evaluate their documents to be sure that the documents fulfill their purpose and to ensure that they can be revised if necessary.
- Collaborate effectively with their peers in a community of writers who provide feedback on each others' work and occasionally write together.
- Write several specific kinds of documents that recur in technical and scientific communities.
- Employ computer technology effectively in the solution of communication problems.
- Communicate in an ethically responsible manner.

There are, of course, several options for creating a syllabus that will meet the course objectives. One approach is to have students write one long "term paper." Another, used by Ms. Ford, is to have students write several short memos and reports. Students at Penn State Altoona who were

enrolled in Ms. Ford's sections of English 202C in the spring semester of 1998 were required to write 11 memos and reports. The goal was to have students replicate, as nearly as possible, the types of writing situations they will face early in their careers.

Students taking this course were enrolled in a variety of majors. Not all were engineering or engineering technology majors. Of 46 students enrolled in Ms. Ford's two sections of the course, 11 were EMET majors, 5 were ENGR majors, 1 was a Geo-environmental Engineering major, and 1 was a 2-year Mechanical Engineering Technology major. The rest of the students were enrolled in Science (5), Agriculture (3), Environmental Resource Management (3), Earth and Mineral Sciences (2), Microbiology (1), Health and Human Development (1), Biology (1), Biobehavioral Health (1), Animal Bioscience (1), Turfgrass (1), Undecided (6), Nondegree (2), and 1 2-year Liberal Arts. Because not all the students were engineering majors, the writing activities had to be technical to an extent but not specifically engineering related.

Examples of cases used

One of the assignments was to write a memo that analyzed a website. The case for this project was as follows:

> You have graduated from Penn State and now have your dream job. Your company does not have a presence on the World Wide Web. Take a look at the Web pages of some other companies in your field and select one to analyze in a memo to your boss.

Three weeks before turning in the paper, students had to write a memo to the instructor telling her what websites they would be using for the paper. In this memo to the instructor, students had to describe the role they would be playing for the second memo. All students selected "dream jobs" appropriate to their majors.

This type of case introduces the students to the concept of playing a real-world role for a writing assignment and allows them to think of the reader for a written communication as a "real" person. It helps them practice having a specific purpose for writing, arranging material to satisfy readers' expectations, revealing organization, observing conventional formats for memos, designing tables, evaluating and revising documents, and employing computer technology.

One in-class assignment asked students to work in teams to write a persuasive memo to a messy office mate. The same "Case of the Messy Office Mate" was presented to each team, but each team was instructed to take a different approach (see Appendix A). One team, for example, was to use a chronological strategy to list the many times the office mate ruined a report by spilling something on it or left unfinished food on the desk for days at a time. Another team was told to rant and rave. A student from each team then read the team's memo aloud, and the class discussed the persuasiveness of the memo. After each team had presented its memo, the class rated the effectiveness of all the memos. This exercise was designed to promote active learning and collaborative problem solving. The classes also were introduced to some of the complexities of communicating in a workplace setting.

Two of the writing assignments were linked to a case that required students to play the role of a designer for a very low-tech communications system that would be marketed on a remote island that had no electricity. The scenario for the project was set as follows: Islanders rely on yelling out their windows to communicate with each other. Your company has decided to market a low-tech communication system on the island. This system will be comprised of tin-can phones installed so that the islanders can relay messages around the island.

For the first paper, students were to describe the tin-can phone system for an internal audience in the writer's company. Technicians would use the description to build the system; marketing personnel would use the description to plan the advertising campaign. Students had to build a working model of their tin-can phone system and bring it to class on the day they turned in their papers. The instructor's office looked like a recycling center!

The basic components were the same for each tin-can phone system, but students were to design and build brackets for holding the phones on window sills or walls; these varied greatly. Students enjoyed debating the relative merits of knot vs. button vs. paper clip for conducting sound. Other debates focussed on questions such as the following: Is polyester cord preferable to cotton string? Does the system need a bell, or will the rattle of the can against the bracket be sufficient to alert neighbors to a call? Must string be waterproofed? What constitutes routine maintenance? Should we tell them to cut down nearby trees? What if there is a thunderstorm? Some safety-minded students designed padding to protect users' ears.

The second part of the project required students to write the owners' manual for the tin-can phone system. Because the technology was so simple, students could focus on the writing task at hand. Students again had very lively discussions of ways for the systems' users to signal to the person on the other end of the phone that they could switch from speaker to listener. Do you tug the string? Do you say a code word such as "over"? Some students preferred to solve this problem with a technological fix and designed tin-can phone systems that had four cans—two for listening and two for speaking. Some students drew cartoons for their manuals; several used the college's digital camera to take photos for their manuals. One student provided an outstanding map of the island. The assessment standards for this assignment are attached in Appendix B.

Integration of Communications into Engineering Technology Courses

As the Penn State Altoona engineering technology students progress through the baccalaureate degree engineering technology programs, they are provided with the opportunities to apply the oral and written communication skills they learned in ENGL 202C. Students enrolled in the baccalaureate degree electro-mechanical engineering technology program take a required course called *Quality Control, Inspection, and Design (EMET 350)* in which they make an extensive use of the case study skills they learned in ENGL 202C.

The EMET 350 course is offered every year during the spring semester. This course is an introduction to statistical quality control (SQC), total quality management (TQM), and ISO 9000 quality standards. The instructional model used in this course is based on engineering case studies. Like its law and business school counterparts, the engineering case presents a scenario that practicing engineers are likely to encounter in the workplace. The engineering cases

developed for this course are derived from actual industry situations and reflected real-world concerns. Providing students with case experiences can be viewed as equipping future engineers/engineering technologists with the tools they will need to effectively perform in industry.

An engineering case is defined as an account of an engineering activity, event, or problem containing some of the background and complexities usually encountered by an engineer/engineering technologist. In his paper, "On Writing Engineering Cases," published in the *Proceedings of ASEE National Conference on Engineering Case Studies*, March 1979, Geza Kardos explained the objectives and content of engineering case studies as

The Major objective of an Engineering Case is to provide a medium through which learning (e.g. analyzing, applying knowledge, reasoning, drawing conclusions) takes place. Imparting additional specific information is relatively minor and coincidental. A good case

1. Is taken from real life (a necessity).
2. Consists of one or more parts, each part usually ending with problems and/or points for discussion.
3. Includes sufficient data for the reader to treat problems and issues.

To make a case believable to the reader, a good case usually includes

1. Setting
2. Personalities
3. Sequence of events
4. Problems
5. Conflicts

The engineering case studies used in EMET 350 are derived from actual industry situations and are developed by the course instructor (Sohail Anwar). Every case study consists of four components. They are:

1. An examination of the situation that existed for a given industrial process before statistical quality control (SQC) was used for this process. The examination includes process description, technologies and tools used, and an analysis of the performance of this process.
2. An examination of all the technical problems which were associated with the performance of the above-mentioned industrial process.
3. An examination of all the possible solutions for the problem described above and the engineering considerations associated with these solutions.
4. An examination of the engineering considerations which led to the implementation of (an) SQC system for the given process.

During every spring semester, teams (each consisting of 2 students) of the EMET 350 students are formed. Towards the middle of the semester, the student teams start getting the case studies from the course instructor. Student teams are required to conduct a written analysis of each case

study. These teams are also required to make a 5-minute oral presentation on each case study analyzed by them.

Besides the use of engineering case studies in EMET 350, the BSEMET students are required to complete written assignments in every course. The assignments may include research papers, technical reports, email reports, or lab books. Assignments are evaluated on the basis of technical merit and on the quality of writing and written presentation. Many courses also require team projects. In these projects, students are provided training in teamwork, required to work in teams, and team performance is carefully evaluated. In Computer Science courses, students are required to turn in all work on disk. Oral communications are required in most courses. The weight assigned to oral projects ranges from 10% to 35%. These projects include class participation, oral presentations, and reports. The presentations in some classes are graded by all members of the audience for good oral communication skills, quality of presentation material, and organization of the material. Specific examples of how oral and written assignments are evaluated include:

ET 002 Introduction to Engineering Technology

This is the first technical course all engineering technology, and students are required to complete weekly writing assignments. Examples of assignments include letters of introduction, resumes, career evaluations, and a technical report that requires the integration of word processing, spreadsheets, and AutoCAD files.

IET 101 Manufacturing Materials and Processes

All exams are conceptual and require that students explain the theory involved in the course. Also, the final project involves a paper and presentation on any topic that is related to materials or manufacturing. The project comprises twenty percent of the student's final grade. Papers are limited to ten pages, including figures, footnotes, etc. Presentations are ten minutes long. Papers are graded for content (50 points), organization (10 points), and grammar, etc. (10 points). Presentations are graded for knowledge of subject (10 points), organization (10 points), and delivery (10 points).

IET 216 Production Design Lab

Reports are required for each topic covered in the course.

EGT 201 Advanced Auto CAD

A final written project report is required at the end of the semester along with an oral presentation, which is video taped.

EMET 430 Automated Machine Control Technology

Students have three major writing assignments that cover a broad range of manufacturing technology topics and product designs. The students have to make presentations on their designs and projects. Word for Windows templates are supplied for report format.

EMET 440 Electro-Mechanical Project Design

Student work is centered on a major project that is presented orally and in written reports. Students have to provide regular progress reports, and project planning, including the use of Gantt charts. Communication is emphasized and students have regular team meetings, faculty advisor meetings, and have to communicate on a regular basis with vendors through email and the phone. They generate a comprehensive final report that has drafts required at several stages during the semester. At the end of the course they make a formal presentation on their work to an audience that includes peers, other BSEMET students, representatives from the Technical Advisory Committee, other industry representatives, and interested college faculty.

Conclusion

The approach to teaching technical communications to engineering technology students (and other students) outlined in this paper has worked well for us. Feedback from students who have had internships after taking Technical Writing and the engineering courses in which written and oral communications are required has been very positive. Several students reported that they received many compliments on their writing skills during their internships. One student, in particular, reported that his internship supervisor told him not to apply for any jobs with other companies. Because of the student's solid engineering skills and his outstanding writing skills, the company planned to make him an offer he couldn't refuse.

Appendix A, In-class exercise
The case of the messy office mate

Your office mate is a slob. Some of the people in the department kid him about his messy desk, his coffee cups with the cure for cancer growing in them, his filing system that makes finding anything impossible, and his lack of telephone manners.

You don't think it's a joking matter. You're sick of sharing a pigsty. You're sick of the smell of three-day-old tuna sandwiches. You've asked him on several occasions to clean up his act.

Now you are getting worried. Yesterday the department head came in the office, smelled the stench, glanced around, and said, "You guys better clean up this mess. This isn't a teenager's bedroom; it's a professional office." Then he stormed out.

The boss apparently didn't notice that the mess was confined to your office mate's side of the room. (Of course, the smell permeated the whole room.)

Team One:

You decide to write a memo to your office mate. Tell him you want him to clean up his side of the office and keep it clean. But remember, you have to share a space with him for who knows how long (maybe years), so be as cooperative as possible in asking him to clean up his act.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of his actions.

Team Two:

You decide to write a memo to your office mate. You know that he is hopeless, so your real purpose is not to persuade him to change but to get this off your chest. Rant. Rave. Really let all your frustrations out.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of his actions.

Team Three:

You decide to write a memo to your office mate. Use a chronological arrangement strategy to remind him of all the many times you asked him to change his ways. Be specific about the incidents that led you to ask him to clean things up.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of his actions.

Team Four:

You decide to write a memo to your office mate. Use a topical arrangement strategy to highlight the reasons he should clean up his office. Focus on the benefits to him.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of her actions.

Team Five:

You decide to write a memo to your office mate. Use exemplification to convince him that this is a serious problem. Be specific about the incidents that led you to ask him to clean things up.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of his actions.

Team Six:

You decide to write a memo to your office mate. Use a process description to tell him how to clean up his act.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of his actions.

Team Seven:

You decide to write a memo to your office mate. Use classification to explain to him how the office files should be organized.

Make sure you keep a copy of the memo for your files. If your office mate doesn't do as you request, you don't want to share the consequences of his actions.

Appendix B. Grading Standards for Paper 5
Owner's Manual for Tin-Can Phones
English 202C.1 & 3 _____ Name
Spring 1998
Ms. Ford

Attach this form to your paper when you turn it in.
Due by 5:00 p.m. on May 7, 1998.

Element	Possible points	Points deducted	Points earned
Content: Are the topic and purpose clear? Does the document effectively instruct the intended users? -3 points for every place that could be more specific.	30		
Format: Use a format suitable for an owner's manual. Use clear headings. (See Chapter 15.) -5 points for each improper or unclear element.	50		
Graphics: Does the manual use appropriate tables, drawings, or graphs? -5 points for each improper graphical element.	50		
Paragraphs: Does each paragraph stick to one topic? -2 points for each paragraph that is improperly developed.	20		
Grammar: -2 point for each grammatical error. (See lists inside back cover.)	20		
Readability: -3 points for each unreadable element. (See pp. 112-113.) Avoid jargon and pompous language. Use active verbs and make them *action* verbs. (See p. 372.) Make sure all lists are parallel.	30		
Total	200		

Provide a self-addressed stamped envelope (with sufficient postage) if you would like your final project to be mailed to you; otherwise, you may pick up your project during the first six weeks of fall semester. After that time, I will shred all projects not picked up. Have a great summer!

PAULA FORD
Paula Ford is the coordinator of the Learning Resources Center at Penn State Altoona. She received her B.A. in English literature and her M.A. in technical writing from The Pennsylvania State University at University Park. In addition to her administrative job, she occasionally teaches a section of technical writing or business writing. She also has over 15 years' experience as a technical writer.

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